A PROCESS IMPROVEMENT FRAMEWORK INTEGRATING LEAN METHODOLOGY AND DECISION TOOLS IN MANUFACTURING INDUSTRY

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A PROCESS IMPROVEMENT FRAMEWORK INTEGRATING LEAN METHODOLOGY AND DECISION TOOLS IN MANUFACTURING INDUSTRY

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SATU RANGKA KERJA PENAMBAHBAIKAN PROSES MENINTEGRASIKAN LEAN METODOLOGI DAN ALAT MEMBUAT KEPUTUSAN DALAM INDUSTRI PEMBUATAN

ABSTRAK

Untuk bersaing dalam dunia proses kelajuan tinggi hari ini , proses penambahbaikan kepada kualiti dan produktiviti telah menjadi satu strategi perniagaan yang penting bagi banyak organisasi termasuk pengeluar , pengedar , syarikat-syarikat pengangkutan, organisasi perkhidmatan kewangan , penyedia penjagaan kesihatan, dan agensi-agensi kerajaan. Kualiti dan produktiviti adalah sangat penting untuk perniagaan syarikat. Kualiti adalah alat kompetitif yang boleh menggembirakan pelanggan dengan meningkatkan dan mengawal kualiti mempunyai potensi untuk menguasai pesaingnya , namun peningkatan produktiviti memaksimumkan nilai pelanggan manakala mengurangkan bahan buangan, matlamat utama adalah untuk memberikan nilai terbaik untuk pelanggan melalui proses penciptaan nilai sempurna yang mempunyai sifar sisa. Untuk mencapai matlamat ini, Lean metodologi adalah cara yang paling sesuai; walau bagaimanapun, disebabkan oleh kekurangan pengetahuan dan keupayaan, terutamanya bagi pelaksana baru, ini akan menyebabkan banyak syarikat gagal untuk mendapatkan faedah yang maksimum daripada penambahbaikan proses mereka. Dalam hal ini, alat membuat keputusan boleh dianggap sebagai cara yang mudah untuk mengenal pasti dan menyelesaikan masalah kritikal yang dihadapi dalam operasi pengeluaran. Oleh itu objektif kajian ini adalah untuk membangunkan satu rangka kerja yang mengintegrasikan alat membuat

keputusan ke dalam Lean metodologi untuk penambahbaikan proses dan dapat memberi petunjuk kepada pelaksana semasa menjalankan penambahbaikan proses.

Dapatan kajian menunjukkan bahawa kebanyakan rangka kerja mempunyai kelemahan yang sama seperti tidak berupaya mengemukakan maklumat yang mencukupi serta dapat membimbing pelaksana melalui keseluruhan projek terutamanya bagi pelaksana baru. Selain itu, sebahagian besar daripada rangka kerja yang terdapat dalam kesusasteraan adalah lebih sesuai untuk digunakan oleh pengalaman pelaksana kerana rangka kerja yang tidak memberi panduan yang mencukupi serta tidak dapat memberitahu pelaksana yang bagaimana yang perlu dilakukan dan apa yang perlu dilakukan seterusnya. Terdapat keperluan untuk membangunkan satu rangka kerja proses penambahbaikan untuk mengatasi kelemahan dan pujian serta untuk memperkayakan sastera yang sedia ada pada rangka kerja penambahbaikan proses. Dengan menggunakan struktur yang sesuai dan kaedah terperinci serta memenuhi keperluan reka bentuk rangka kerja empat, rangka kerja yang dicadangkan itu secara berkesan boleh membantu pelaksana sama ada berpengalaman atau orang baru dalam melaksanakan penambahbaikan proses.

Gabungan baru rangka kerja Lean dan alat membuat keputusan adalah mencukupi bagi memastikan proses dan peningkatan produktiviti projek yang berjaya dan telah berjaya dibangunkan dalam kajian ini. Dengan menggunakan garis daripada rangka kerja ini, seorang pelaksana yang menggunakan rangka kerja yang tepat boleh menentukan hala tuju projek, melaksanakan penilaian proses untuk mengenal pasti punca kepada kegagalan atau masalah, dan menilai penyelesaian yang berdaya maju untuk dilaksanakan. Oleh itu, matlamat utama kajian ini adalah untuk meningkatkan penambahbaikan proses dan produktiviti dengan menyediakan rangka kerja yang mantap

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ABSTRACT

To compete in the current high-speed environment, process improvement in quality and productivity has become an essential business strategy for numerous organizations, including manufacturers, distributors, transportation companies, financial services organizations, health care providers, and governmental agencies. Quality and productivity are critically important for business. The ultimate goal of business is to provide value to customers through a seamless value creation process that has zero waste. Lean is the suitable methodology in achieving this goal. However, several companies fail to gain the maximum benefit from their process improvement efforts because of lack of knowledge and capability, particularly if the implementer is new. In this regard, decision-making tools can be considered a structured problem-solving approach that uses simple standardized tools for identifying and resolving critical problems encountered in manufacturing operations. Therefore, this research primarily aims to develop a framework that integrates decision-making tools with lean methodology for process improvement, thus effectively guiding the implementer in performing process improvement.

Findings indicate that the majority of existing frameworks have similar weaknesses, such as incapacity to present sufficient information and inability to guide implementers, particularly novice ones, throughout the entire project. Moreover, most of the frameworks in the literature are more suitable for adoption by experienced implementers because these frameworks do not provide sufficient guidance and do

not instruct implementers on how to perform process improvement and what subsequent actions to undertake. A process improvement framework should be developed to overcome the weaknesses as well as complement and enrich the existing literature on process improvement frameworks. By applying the appropriate structure and a detailed methodology as well as fulfilling the framework design requirements, the proposed framework may effectively assist implementers, either experienced or novice, in performing process improvement.

The proposed framework, which combines lean and decision-making tools, is sufficient to ensure a successful process and productivity improvement project. Using the outline from this framework allows implementers to accurately define the project direction, perform process assessment to identify the root cause of a failure or problem, and evaluate viable solutions for implementation. Consequently, this research ultimately aims to enhance the process and productivity improvement by providing a robust framework.

Chapter 1

INTRODUCTION

1.0 Overview

The introduction is divided into five sections. Section 1.1 provides an overview of the research background. Section 1.2 describes the research problem. Section 1.3 discusses the research objectives. Section 1.4 deals with the research scope, and Section 1.5 presents the thesis layout.

1.1 Background

In the dynamic and competitive industrial arena, organizations are faced with a highly competitive market because of the rapid change in global market conditions. Companies share a common set of goals when dealing with its current business to gain the most profit and to lead its business to optimum growth in the future (Lewis & Boyer, 2002). To achieve these goals, companies should start by targeting activities and processes that will enable them to ensure the on-time delivery of goods and services to their customers. Once these activities have been identified, new and greater quality products that will delight customers should be determined (Terziovski et al., 2000). Therefore, continuous process improvement should be one of the philosophies guiding a company. A company with a strong and continuous improvement process is more likely to survive and grow.

Process improvement is important because it improves quality, thus utilizing production capacity and controlling costs (Bradley et al., 2011). Lean manufacturing philosophy is at the forefront in today's operations management and quality improvement practices. It is characterized by this goal of maximizing productivity (Brown et al., 2008). Its primary focus is to minimize wastage, reduce variation in

standards and to improve production quality (Nave, 2002). It also reduces cycle time, increases flexibility, and improves productivity (Hobbs, 2004). The driving force of lean manufacturing is the process of continuous improvement through the elimination of waste or non-value adding activities (Burton and Boeder, 2003). Recognizing the root cause and systematically seeking solutions are key to eliminating wastage problems. In this regard, decision-making tools can be considered a structured problem-solving approach that uses simple standardized tools for identifying and resolving critical problems encountered in manufacturing operations. Professionals often use decision-making tools for solving quality problems. Among the most commonly used decision-making tools are cause-and-effect diagram (Doggett, 2005), why–why analysis (Pinsky, 2003), failure mode effect analysis (FMEA), and Pareto chart analysis (Hall et al., 2000). Decision-making tools involve data collection, causal factor charting, root cause identification, and recommendation generation and implementation (Rooney et al., 2004). The process of deploying decision-making tools always begins with the data collection phase, followed by the analysis phase, and ends with the solution phase (Ransom, 2008).

Lean and decision-making tools can be combined to become a more comprehensive methodology. Combining the two methodologies provides a structured approach for helping companies focus on doing things right. Therefore, the combined methodology adds value for the customer and creates an effective and efficient organization (George et al., 2004). However, not all process improvements generate successful results (Browning et al., 2008). This phenomenon is attributed to a lack of understanding of the methodology and the inability of the implementer to perform process improvement (Frank & Hung, 2009). Moreover, available frameworks that may help effectively implement process improvement in a systematic manner

(beginning from project sketch up to project completion by providing a detailed description of each element of the framework) are in short supply.

1.2 Problem Statement

Lean production lacks a systematic framework that may be followed. More often, it resolves problems in the short term; therefore, tracking project performance after its implementation is not conducted. Furthermore, lean does not offer a mathematical analysis of a process. Not every company is successful in its initial attempt to go lean (Rathje et al., 2009). Lean manage the project with bottom-up approach; therefore, the conceptual description of lean production should be clarified, and operating measurements must be more concretely stated. Lack of management commitment, absence of team initiative, and inefficiency of company communication similarly affect lean project completion. These specific complications cause the premature termination of a lean project (Eroglu et al., 2011). Moreover, for the lean implementer, selecting a proper tool from a wide range of tools is difficult. Although plenty of tools are available for improvement projects, identifying the most suitable one is an immense task; moreover, using lean tools simultaneously only induces confusion. Thus, selecting the proper lean tools to be utilized at the proper time and at the right position always needs extensive knowledge and understanding of lean implementation (Rathje et al., 2009).

Implementing lean production systems is a process that includes assessing current situation and designing a production system based on lean system concepts and techniques for waste reduction. The seven classical types of waste are: transport, inventory, motion, waiting, overproduction, over processing and defects. Womack

and Jones (2003) propose the five principles for guiding lean production implementation. Rother and Shook (2003) propose a sequence of eight steps to plan the design of a future state lean production system. The evolution from current to future state is a continuous process that may require many Kaizen projects to eliminate or reduce all sort of waste that may prevent leanness. Therefore, a fundamental aspect in planning lean production implementation and improvement is required on deciding types of waste that should be reduced first. However, as most of the improvement initiatives, there are several problems that can hinder improvement expected after lean production implementation. As survey conducted by Lean Enterprise Institute (2008) points out a number of obstacles. There three most cited ones are backsliding, middle management resistance and lack of implementation know-how. Gurumurthy and Kodali (2011) also points lack of understanding regarding how to implement lean production as one of the main reasons for failures. Following the same line of argument, Sawhney et al. (2010) also point lack of planning as one of the causes of unsuccessful lean system implementation.

This research attempts to provide a novel approach for overcoming this limitation. It uses decision-making tools as an advanced evaluation technique for customer satisfaction and integrates these tools with lean methodology to ensure the smooth operations of improvement projects. A different contribution to the problem of defining priorities to reduce different types of waste can be made by employing decision-making tools such as failure mode and effect analysis (FMEA) technique to analyze waste modes. FMEA is a well-known technique for improving the quality of products and processes. It systematically prioritizes improvement actions based on the analysis of the severity, occurrence, and detectability of failure modes (Sankar & Prabhu, 2001). Decision-making tools such as 5 Whys analysis are adopted in solving

manufacturing problems. The 5 Whys analysis tool is useful for understanding the root cause of problems and is characterized by significant depth and breadth. The root causes are typically deep, and the corrective actions at such deep levels are broadly based and long term (Alukal, 2007). The Pareto chart is adopted in analyzing non-numeric data, such as "cause," "type," and "classification," and in determining priorities on which action and process changes should be focused; it is also commonly used for identifying downtime and other sources of wastage (Hall et al., 2000). The Pareto chart uses bar graphs to sort problems according to severity, frequency, nature, or source, and displays them according to size to distinguish the most important problems from the least important ones.

Detailed guidance and systematic sequencing are required to deploy process improvement (Wan et al., 2009); both factors will help the implementer apply the process improvement to achieve company goals. Only a few researchers have discussed and are interested in the process of enhancing the framework that combines lean and decision-making tools.

As an initial effort toward filling this gap and overcoming the stated problems, a new combination of lean and decision-making tools will be the main focus of this research. The combined methodology can serve as a new project improvement guidance tool for increasing the success rate of improvement in the industrial environment.

1.3 Research Objectives

The main objective of this research is to set up a new framework that integrate Lean and decision making tools that is aligned with the company philosophy and can be adopted by the company in its quest for lean implementation. This framework will

eventually facilitate major improvements in the product quality, cost, and delivery performance of a company. The specific objectives of this research are as follows:

1. To investigate the similarities of lean and decision making tools
2. To develop a framework that combines lean and decision making tools
3. To validate the developed framework to determine the prospective practical usage of the framework through case studies

1.4 Scope of Research

This research primarily aims to combine lean principles and the decision making tools to achieve an enhanced continuous improvement framework. This framework does not remain to be merely theoretical; it will also be applied in an actual company setup. Thus, the scope of this research is a case study using the new combination of lean and decision making tools framework to implement productivity and quality improvement initiatives to prove the capabilities of the framework. The framework must be capable of providing guidance to implementers of a strategic structure for increasing productive efficiency and output. Introducing the new framework with combination of Lean and decision making tools allows company to eliminate waste, stabilize processes, satisfy customers, and achieve cost effectiveness to achieve business goals. The framework will also be piloted and validated by conducting two case studies in a company. By contrast, a new practitioner will act as the implementer in the case study validation to determine if the new combine framework can easily be followed and applied from project sketch to completion by a new implementer with no experience.

1.5 Layout of the Thesis

This thesis is divided into seven chapters. Chapter 1 provides a brief overview of the current issues and problems faced in the process improvement implementation, research objectives, and scope of research. Chapter 2 presents the detailed literature review, which is related to the background theories adopted in the research. Chapter 3 explains the development of the model. Chapter 4 presents the detailed elements of the framework—from defining the project to project completion. Chapter 5 focuses on the case study validation that was conducted at two different process departments in the company. Chapter 6 presents the overall discussion and lessons learned through the case study validation. Finally, Chapter 7 discusses all of the important findings, research conclusion, and the recommendations for future research.

Chapter 2

Literature Review

2.0 Overview

This chapter explores and summarizes the related literature on process improvement implementation using the lean methodology and decision making tool. It provides the basis for designing and developing the research instruments and performing the final analysis. This chapter is divided into four sections. The need for and the requirements of continuous improvement in a company are reviewed in Section 2.1. The definition, history, methodology, and examples of lean and decision making tools are discussed in Sections 2.2 and 2.3, respectively. Findings from the literature review are discussed in Section 2.4, and a summary of the chapter is presented in Section 2.5.

2.1 Concept of continuous improvement

A company can remain in the market if it continues to earn profit and keeps its customers excited about its products. Therefore, product improvement by incremental development is the heart of any sustained business venture (Gilvan et al., 2004). Continuous improvement is an approach for measuring, analyzing, and improving the company business processes by producing breakthrough results in terms of market penetration, product quality attributes, quality assurance, manufacturing processes, customer satisfaction, cycle time, and the cost of doing business. Continuous improvements are always a key to the success of product development (Jorgensen , 2003). The integrated continuous improvement approach accommodates both incremental continuous improvement and radical process redesign. When a company